Action Plan for Scientific Studies to Assess the Effectiveness of the Directions in the Forest Management Guide for Natural Disturbance Pattern Emulation (ver. 3.1)

This document was prepared in response to Condition 39c of the Declaration Order (MNR-71) made under the *Environmental Assessment Act* regarding MNR's Class Environmental Assessment Approval for Forest Management on Crown Lands in Ontario. The Condition states that:

> *Within one year of this Declaration Order coming into force, MNR shall complete an action plan which shall describe scientific studies that shall assess the effectiveness of the direction for clearcut sizes, separation criteria for planned clearcuts, and standards for residual stand structure in MNR's approved forest management guide relating to the emulation of natural disturbance patterns, in providing for the emulation of natural disturbance patterns. The action plan shall include implementation schedules for these scientific studies.*

This action plan was developed under terms of reference provided by MNR's EA Steering Committee (Appendix 1).

The process for developing the action plan is outlined first, followed by the action plan (i.e., the list of scientific studies and their implementation schedule). This document concludes with a brief discussion of opportunities to transfer and implement the new knowledge gained from the proposed studies. An overview of the process is illustrated in Figure 1.

1. Developing the action plan

1.1 Scope of the task

- The Forest Management Guide for Natural Disturbance Pattern Emulation (NDPE Guide V3.1; 2001; hereafter referred to as the Guide) addresses emulation of stand-replacing fire disturbance patterns using the clearcut silvicultural system within boreal and Great Lakes-St. Lawrence forests. As required by Condition 39c, this action plan focuses on those areas in Ontario where stand-replacing fires and clearcut silviculture prevail (primarily the boreal forest). Its relevance to Great Lakes-St. Lawrence forests is limited to those areas where stand-replacing fires naturally occur. Studies assessing the Guide's direction for shelterwood silvicultural systems (i.e., non-stand replacing fires) are not included in this action plan.

- The goal of the Guide is to create forest landscapes that "resemble more closely the landscapes recently created naturally by fire ... with respect to the location and sizes of disturbances, residual stand structure, ...". The specific directions in the Guide are:

(1) to create a more natural landscape pattern by planning harvest patterns to meet a specified (a) size-class distribution; and (b) patch separation distance;
(2) to leave a more natural structural legacy by planning harvest patterns to leave a specified (a) residual patch area; and (b) number of residual trees.

- The effectiveness of the Guide can be assessed in two ways:
  (1) assessing the effectiveness of the Guide's directions (i.e., are the directions provided correct?) and
  (2) assessing the effectiveness of the outcome of the Guide's directions, having applied the directions correctly (i.e., were the expected results of applying the Guide achieved, assuming the Guide's directions were feasible to implement and applied correctly?).

- The goal of this action plan is to assess the effectiveness of the Guide's directions. It does not address the effectiveness of the Guide's outcome, which are expected to be addressed by other conditions of the Declaration Order, for example Condition 29 (silvicultural effectiveness monitoring) and Condition 31 (monitoring guide effectiveness).

- This action plan focuses on assessing the effectiveness of the Guide's directions from an ecological perspective; economic and social perspectives are beyond the scope of this exercise. This action plan provides a list of scientific studies to be pursued to verify the directions of the guide, providing details of the study goal, nature, participants, time frames, reporting procedures, proposed products, and anticipated new knowledge.

- Plans for implementing the study findings are beyond the scope of this exercise and therefore are not addressed in detail. Some possible options and expectations for transferring the knowledge gained from these proposed studies are briefly addressed in Section 3.

1.2 Identifying knowledge uncertainties and developing testable hypotheses

- Given the goal of the Guide, the effectiveness of the Guide's directions will be determined by the degree of similarity between natural fire patterns and the harvest patterns prescribed by the Guide. That is, how similar are the directions in the Guide to natural disturbance patterns resulting from fire? Based on the EA Condition 39c, the Guide directions were separated into four criteria: clearcut size pattern, clearcut patch separation, residual patch area, and residual trees. The effectiveness of these criteria is assessed by their similarity to published knowledge on natural fire disturbances. If sufficient scientific evidence on natural fire disturbances relevant to the Guide's directions exists to support each criterion, then the associated knowledge uncertainty is low, and therefore those directions can be considered effective. Conversely, if scientific evidence on natural fire disturbances is scarce, inconsistent, or does not support the Guide's directions for a criterion, then the associated

knowledge uncertainty is high. These directions are considered to require further scientific study, to verify their effectiveness.

- A preliminary literature review was used to identify the degree of knowledge uncertainty associated with each criterion, as explained above. The scientific literature on natural fire disturbances, including journal papers, books, graduate theses, and technical reports, was reviewed (over 1000 citations) and evaluated for direct evidence (support/refute) and strength of evidence (facts, hypotheses, no evidence) in relation to the ecological foundation for the four criteria (i.e., fire disturbance size patterns, fire disturbance patch separation, post-fire residual patch area, and post-fire residual trees).

- Based on the results of the literature review and with input from science experts, the knowledge uncertainties were converted into testable scientific hypotheses. Subsequently, a brief survey was conducted within the broader research community to examine whether these hypotheses are being studied in the boreal and Great Lakes-St. Lawrence regions in Canada and the United States. Four broad study groupings were developed to test the hypotheses that were not reported as being examined elsewhere. Several techniques (e.g., simulation modelling, literature reviews, historical fire analyses, and current fire surveys) are proposed to test these hypotheses. For each study group, the most appropriate methods for testing those hypotheses were chosen based on review of science literature, expert opinion, and feasibility. At least two research study techniques are proposed to assess each of the four criteria being examined.

- Information from the preliminary literature review will form an interim published product* that is expected to contain an annotated bibliography, a synthesis of trends in the literature, and a register of related ongoing research studies.

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* Available as an MNR technical report fall 2004.

2. Proposed scientific studies and implementation schedule

The following studies are proposed to assess the effectiveness of the directions in the Guide by improving the understanding of Ontario's natural fire regimes. For each of the four criteria, broad study groupings that comprise a series of sub-studies are provided. Studies are provided in pairs (for example, a simulation study and a survey of historical data for Criterion 2), the results of which supplement one another. Proposed literature reviews are intended to capture the state of broader scientific knowledge beyond what was used to develop the Guide. For each study, a goal statement, brief description of approach, contributors, time frame, and proposed products are listed. The expected knowledge is described by a series of examples, ranging from broad to specific, the latter relating to the Guide's directions.

2.1 Criterion 1: Landscape Harvest Patterns – Size Patterns

The current scientific knowledge (based on a preliminary review of published reports, books, and journal papers) on fire disturbance size patterns is limited and inconsistent. Therefore, the knowledge uncertainty about the size-class patterns in naturally occurring fire disturbances and associated directions for harvest size pattern in the Guide is considerable. The following studies are proposed to address these knowledge uncertainties.

Study 1 – Size patterns

Goal: To describe the naturally occurring fire disturbance patch size distribution and its variation in Ontario's fire-driven forest landscapes at eco-regional scale.

Study Approach: This study will consist of spatial simulation modelling of the forest fire regime in Ontario's boreal forest by eco-regions detailed in the Guide (3E, 3W, 3S, 4S, and portions of 4E). Great Lakes-St. Lawrence forests will be studied in eco-regions where stand-replacing fires prevail (4W, portions of 4E, 5E, and 5S). An Ontario-specific model will be used for these simulations.

OMNR Contributors:

- Applied Research and Development Branch – Forest Research and Development Section (Lead)
- Forest Management Branch – Forest Policy Section

Timeframe: Three years; beginning April 2005 and concluding April 2008

Reporting Procedures:

- Annual reporting of progress and interim findings to EA Condition steering committee and Provincial Forest Technical Committee
- Provincial Annual Report on Forest Management (as specified by Condition 39d)
- Five-Year EA (environmental assessment) Report (as specified by Condition 39e)

Proposed Products: In addition to updates in the Provincial Annual Report on Forest Management and Five-Year EA Reports, products are expected to include:

- New information on size-class distribution of fire disturbance patches at eco-regional scale to support Guide revision
- Final report on study findings

New Knowledge Expected: Upon completion of this study, new information is anticipated about the distribution of the natural fire disturbance patch sizes in Ontario's forests over time and in space, including:

- the likelihood of specific fire disturbance patch size classes; for example, what is the shape of the size-class distribution curve? Is 80% of the burned area within boreal fire disturbance patches less than 260 ha as per Guide directions for planned clearcuts?
- the variability of the likelihood of fire disturbance patch size classes among eco-regions; for example, does the shape of the size-class distribution curve change from eco-region to eco-region? If 80% of the burned area within boreal fire disturbance patches is less than 260 ha, is this true for all eco-regions as per Guide directions for planned clearcuts?
- the variability of the likelihood of fire disturbance patch size classes within eco-regions; for example, does the shape of the size-class distribution curve change within eco-regions? If 80% of the burned area within boreal fire disturbance patches is less than 260 ha, is this true everywhere within each eco-region as per Guide directions for planned clearcuts?
- the variability of the likelihood of fire disturbance patch sizes through time; for example, does the shape of the size-class distribution curve change through time? If 80% of the burned area within boreal fire disturbance patches is less than 260 ha, is this true through time as per Guide directions for planned clearcuts?

Study 2 – Size patterns

Goal: To understand Ontario's natural fire disturbance patch size distribution in the boreal forest biome in a broad North American context, as a supplement to Study 1.

Study Approach: This study will consist of a systematic analysis of the published literature related to fire disturbance patch size distribution in the boreal forest biome in North America.

OMNR Contributors:

- Applied Research and Development Branch – Forest Research and Development Section (Lead)
- Forest Management Branch – Forest Policy Section

Timeframe: One year; beginning April 2005 and ending April 2006

Reporting Procedures:

- Annual reporting of progress and interim findings to EA Condition steering committee and Provincial Forest Technical Committee
- Provincial Annual Report on Forest Management (as specified by Condition 39d)
- Five-Year EA (environmental assessment) Report (as specified by Condition 39e)

Proposed Products: In addition to updates in the Provincial Annual Report on Forest Management and Five-Year EA Reports, products are expected to include:

- Supplementary information on size-class distribution of fire disturbance patches to support Guide revision
- Report on literature review findings

New Knowledge Expected: Upon completion of this study, supplementary information is anticipated about the general trends in fire disturbance patch size distribution in the boreal forest biome across North America as found by other scientific studies to compare with findings from Ontario (e.g., Study 1).

2.2 Criterion 2: Landscape Harvest Patterns – Patch Separation

The current scientific knowledge (based on a preliminary review of published reports, books, and journal papers) on fire disturbance patch separation is non-existent. Therefore, the knowledge uncertainty about the patch separation patterns in naturally occurring fire disturbances and associated directions for patch separation in the Guide is extremely high. The following studies are proposed to address this knowledge uncertainty.

Study 3 – Patch separation

Goal: To describe the spatial pattern of fire disturbance patches that could potentially occur naturally at landscape scale and its variation.

Study Approach: This study will consist of spatial simulation modelling of the forest fire regime in Ontario's boreal forest by eco-regions detailed in the Guide (3E, 3W, 3S, 4S, and portions of 4E). Great Lakes-St. Lawrence forest will be studied where stand-replacing fires prevail (4W, portions of 4E, 5E, and 5S), focusing on the landscape-scale (within each eco-region) patterns of fire disturbance patch occurrence. An Ontario-specific model will be used for these simulations.

OMNR Contributors:

- Applied Research and Development Branch – Forest Research and Development Section (Lead)
- Forest Management Branch – Forest Policy Section

Timeframe: Three years; beginning April 2005 and ending April 2008

Reporting Procedures:

- Annual reporting of progress and interim findings to EA Condition steering committee and Provincial Forest Technical Committee
- Provincial Annual Report on Forest Management (as specified by Condition 39d)
- Five-Year EA (environmental assessment) Report (as specified by Condition 39e)

Proposed Products: In addition to updates in the Provincial Annual Report on Forest Management and Five-Year EA Reports, products are expected to include:

- New information on spatial patterns in the potential occurrence of fire disturbance patches at eco-regional scale to support Guide revision
- Final report on study findings

New Knowledge Expected: Upon completion of this study, new information is anticipated about the potential patterns in spatial occurrence of fire disturbance patches in fire-driven forest landscapes, including:

- the local spatial biases in the size-class distribution of fire disturbance; for example, is the chance of occurrence of large fire disturbance patches equal across a landscape, or are they more/less likely to occur in some parts?
- the likelihood of fire disturbance patches overlapping in time and space; for example, what is the likelihood of two adjacent fire disturbance patches merging? How long does it take for fire disturbance patches to merge in space? How is this likelihood influenced by local site factors?
- the likelihood of fire disturbance patch proximity; for example, are smaller patches likely to be closer to one another than larger patches? Are fire disturbance patches always minimally 200 m apart as per Guide directions? Is the distance between fire disturbance patches directly proportional to their size, increasing at a rate of 50 m per 100 ha as per Guide directions?

Study 4 – Patch separation

Goal: To describe the spatial pattern of fire disturbance patches that did occur naturally at landscape scale in boreal Ontario.

Study Approach: This study will analyze a series of historical fire data collected from areas in Ontario where fires have not been suppressed (fire suppression affects size and shape of fires and therefore their spatial pattern).

OMNR Contributors:

- Applied Research and Development Branch – Forest Research and Development Section (Lead)
- Science and Information Branch – Regional Science and Information Sections
- Forest Management Branch – Forest Policy Section

Timeframe: Three years; beginning April 2005 and ending April 2008

Reporting Procedures:

- Annual reporting of progress and interim findings to EA Condition steering committee and Provincial Forest Technical Committee
- Provincial Annual Report on Forest Management (as specified by Condition 39d)
- Five-Year EA (environmental assessment) Report (as specified by Condition 39e)

Proposed Products: In addition to updates in the Provincial Annual Report on Forest Management and Five-Year EA Reports, products are expected to include:

- New information on spatial patterns of historical fire disturbance patches to support Guide revision
- Final report on study findings

New Knowledge Expected: Upon completion of the study, additional information is anticipated on spatial patterns of (unsuppressed) fire disturbance patches that occurred in various parts of Ontario to extend the understanding gained in the simulation study (i.e., Study 3), including:

- the local spatial biases in the size-class distribution of fire disturbance; for example, is the chance of occurrence of large fire disturbance patches equal across a landscape, or are they more/less likely to occur in some parts?
- the likelihood of fire disturbance patches overlapping in time and space; for example, what is the likelihood of two adjacent fire disturbance patches merging? How long does it take for fire disturbance patches to merge in space? How is this likelihood influenced by local site factors?
- the likelihood of fire disturbance patch proximity; for example, are smaller patches likely to be closer to one another than larger patches? Are fire disturbance patches always minimally 200 m apart? Is the distance between patches directly proportional to their size, increasing at a rate of 50 m per 100 ha as per Guide directions?
- additional information will be generated from analyses of current fire patterns (see Study 5)

2.3 Criterion 3: Structural Legacy: Residual Stands

The current scientific knowledge (based on a preliminary review of published reports, books, and journal papers) on post-fire residual stands is sparse and inconsistent. Therefore, the knowledge uncertainty about the residual stand patterns in naturally occurring fire disturbances and associated directions for residual stands in the Guide is high. The following studies are proposed to address this knowledge uncertainty.

Study 5 – Residual patches

Goal: To describe the spatial and temporal patterns of within post-fire disturbance patch residual stands and its variation in Ontario's fire-driven forest landscapes within eco-regions and within landscapes.

Study Approach: This study will analyze a series of current unsuppressed fire disturbance patches of various sizes and locations that represent the variation in landscapes, using large-scale photography and other spatial databases.

OMNR Contributors:

- Applied Research and Development Branch – Forest Research and Development Section (Lead)
- Science and Information Branch – Forest Resource Inventory Unit
- Forest Management Branch – Forest Policy Section

Timeframe: Three years; beginning April 2005 and ending April 2008

Reporting Procedures:

- Annual reporting of progress and interim findings to EA Condition steering committee and Provincial Forest Technical Committee
- Provincial Annual Report on Forest Management (as specified by Condition 39d)
- Five-Year EA (environmental assessment) Report (as specified by Condition 39e)

Proposed Products: In addition to updates in the Provincial Annual Report on Forest Management and Five-Year EA Reports, products are expected to include:

- New information on spatial patterns of residual stands within fire disturbance patches to support Guide revision
- Final report on study findings

New Knowledge Expected: Upon completion of the study, new information is anticipated about patterns of insular and peninsular residual stands (within post-fire disturbance patches) and their variation through time and in space, including:

- the extent of post-fire residual area, in peninsular and insular categories, and causal factors of their variability; for example, does the peninsular residual area range from 8 - 28% and does the insular area range from 2 - 8% as per Guide directions? Is this independent of fire disturbance patch size? What influence do forest type and micro-geoclimatic factors (e.g., ecosite) exert?
- the spatial distribution of residual stands within a fire disturbance; for example, are peninsular and insular areas more likely to occur on certain site features within fire disturbances?
- the size-class distribution of residual stands; for example, are 20% < 5 ha, 35% 5 - 50 ha and 45% > 50 ha as per Guide directions? Is this independent of fire disturbance patch size, forest type, and micro-geoclimatic features?
- re-burn patterns of residual stands; for example, what is the likelihood of residual stands burning within 20 years, and does this depend on the forest type and site features? (information from historical fire study -- see patch separation above)
- temporal changes to residual stands; for example, what is the likelihood of residual stands changing structure and composition within 20 years, and does this depend on the forest type and site features? (information from historical fire study -- see patch separation above)

Study 6 – Residual stands

Goal: To understand Ontario's spatial patterns of within post-fire disturbance patch residual stands and its variation in fire-driven forest landscapes within eco-regions in a broad North American context, as a supplement to Study 5.

Study Approach: This study will consist of a systematic analysis of the published literature related to post-fire residual stands in the boreal forest biome in North America.

OMNR Contributors:
- Applied Research and Development Branch – Forest Research and Development Section (Lead)
- Forest Management Branch – Forest Policy Section

Timeframe: One year; beginning April 2005 and ending April 2006

Reporting Procedures:
- Annual reporting of progress and interim findings to EA Condition steering committee and Provincial Forest Technical Committee
- Provincial Annual Report on Forest Management (as specified by Condition 39d)
- Five-Year EA (environmental assessment) Report (as specified by Condition 39e)

Proposed Products: In addition to updates in the Provincial Annual Report on Forest Management and Five-Year EA Reports, products are expected to include:
- New information on spatial patterns of residual stands within post-fire disturbance patches to support Guide revision
- Publishable report on literature review findings

New Knowledge Expected: Upon completion of this study, supplementary information is anticipated on general patterns in the occurrence and distribution of post-fire residual stands in the boreal forest biome across North America as found by other scientific studies to compare with findings from Ontario (e.g., Study 5).

2.4 Criterion 4: Structural Legacy: Residual Trees and Downed Woody Debris

The current scientific knowledge (based on a preliminary review of published reports, books, and journal papers) on post-fire disturbance residual live trees, snag trees, and downed woody debris exists but is highly inconsistent. Therefore, the knowledge uncertainty about the residual tree patterns and downed woody debris in naturally occurring fire disturbances and associated directions in the Guide is high. The following studies are proposed to better understand this knowledge uncertainty.

Study 7 – Residual Trees and Downed Woody Debris

Goal: To describe the spatial and temporal patterns of within post-fire disturbance patch residual live tree, snag tree, and downed woody debris abundance and distribution and its variation in Ontario's fire-driven forest landscapes.

Study Approach: This study will consist of post-fire field surveys conducted immediately after fire, preferably unsuppressed, and analysis of this information in relation to other spatial data.

OMNR Contributors:

- Applied Research and Development Branch – Forest Research and Development Section (Lead)
- Science and Information Branch – Regional Science and Information Sections
- Northeast, Northwest and Southern Region – Districts and Areas
- Forest Management Branch – Forest Policy Section

Timeframe: Three years; beginning April 2005 and ending April 2008

Reporting Procedures:

- Annual reporting of progress and interim findings to EA Condition steering committee and Provincial Forest Technical Committee
- Provincial Annual Report on Forest Management (as specified by Condition 39d)
- Five-Year EA (environmental assessment) Report (as specified by Condition 39e)

Proposed Products: In addition to updates in the Provincial Annual Report on Forest Management and Five-Year EA Reports, products are expected to include:

- New information on residual live tree, snag tree, and downed woody debris abundance and distribution in post-fire disturbance patches to support Guide revision
- Final report on study findings

New Knowledge Expected: Upon completion of the study, new information is anticipated about patterns of live tree, snag tree, and downed woody debris occurrence and distribution over time and in space within post-fire disturbance patches and its variability, including:

- the number of live residual and snags trees within a fire disturbance patch and its variation; for example, is the minimum average number of residual trees six large-diameter, live stems per ha and 25 stems in total as per Guide directions? Is this independent of fire size, forest type, and micro-geoclimatic factors?
- temporal changes to the number of live residual and snags trees within a fire disturbance patch and its variation; for example, how long do live residual and snag trees remain standing following burns? Is this independent of species, size, and micro-geoclimatic factors?

- amount of downed woody debris within a fire disturbance patch and its variation; for example, is the amount of downed woody debris independent of fire size, forest type, and micro-geoclimatic factors?

Study 8 – Residual Trees and Downed Woody Debris

Goals: To understand the spatial patterns of within post-fire disturbance patch live tree, snag tree, and downed woody debris abundance and distribution, and its variation in fire-driven forest landscapes in a broad North American context, as a supplement to Study 7.

Study Approach: This study will consist of a systematic analysis of the published literature related to within post-fire disturbance patch live tree, snag tree, and downed woody debris abundance in the boreal forest biome in North America.

OMNR Contributors:
- Applied Research and Development Branch – Forest Research and Development Section (Lead)
- Science and Information Branch – Regional Science and Information Sections
- Forest Management Branch – Forest Policy Section

Timeframe: One year; beginning April 2005 and ending April 2006

Reporting Procedures:
- Annual reporting of progress and interim findings to EA Condition steering committee and Provincial Forest Technical Committee
- Provincial Annual Report on Forest Management (as specified by Condition 39d)
- Five-Year EA (environmental assessment) Report (as specified by Condition 39e)

Proposed Products: In addition to updates in the Provincial Annual Report on Forest Management and Five-Year EA Reports, products are expected to include:
- New information on live tree, snag tree, and downed woody debris abundance and distribution in post-fire disturbance patches to support Guide revision
- Publishable report on literature review findings

New Knowledge Expected: Upon completion of this study, supplementary information is anticipated about the general patterns in the occurrence and distribution of within post-fire disturbance patch live tree, snag tree, and downed woody debris abundance in the boreal forest biome across North America as found by other scientific studies to compare with findings from Ontario (e.g., Study 7).

3. Communications and Knowledge Transfer

The results of these studies, when available, are expected to contribute to the development of the new Landscape Guide and other appropriate forest management guides, as well as subsequent revisions to those documents. Periodic updates provided to the Provincial Forest Technical Committee, in Provincial Annual Reports and Five-Year EA Reports will ensure awareness of study progress and provide information about where study findings are documented for use in current and future guide revisions.

Results of some of these studies (i.e., Study 1, 3, 4, 5 and 7) are expected to contribute to the scientific literature. A review paper synthesizing the state of knowledge of natural fire disturbance pertaining to directions in the Guide is also expected to add to the broader scientific literature.

Summary

The Forest Management Guide for Natural Disturbance Pattern Emulation provides guidance for emulating fire patterns using landscape harvest patterns and structural legacy; as captured by specific directions about clearcut size patterns, separation criteria for planned cuts, residual patches, and residual trees. The ecological foundation for these directions was examined by reviewing the published knowledge on fire disturbance patterns. In doing so, the degree of knowledge uncertainty associated with the directions was determined, and relevant scientific questions formulated to reduce these knowledge uncertainties. The broad scientific study groups proposed in this action plan address these questions with the intent of developing new and reliable knowledge related to the four directions at a nested hierarchy of spatial scales, within a three-year period beginning in April 2005 and ending in April 2008. Several periodic reporting mechanisms will ensure that the progress of scientific studies is monitored and new knowledge is made available for future guide revisions. Figure 1 provides an overview of the development and details of the action plan.

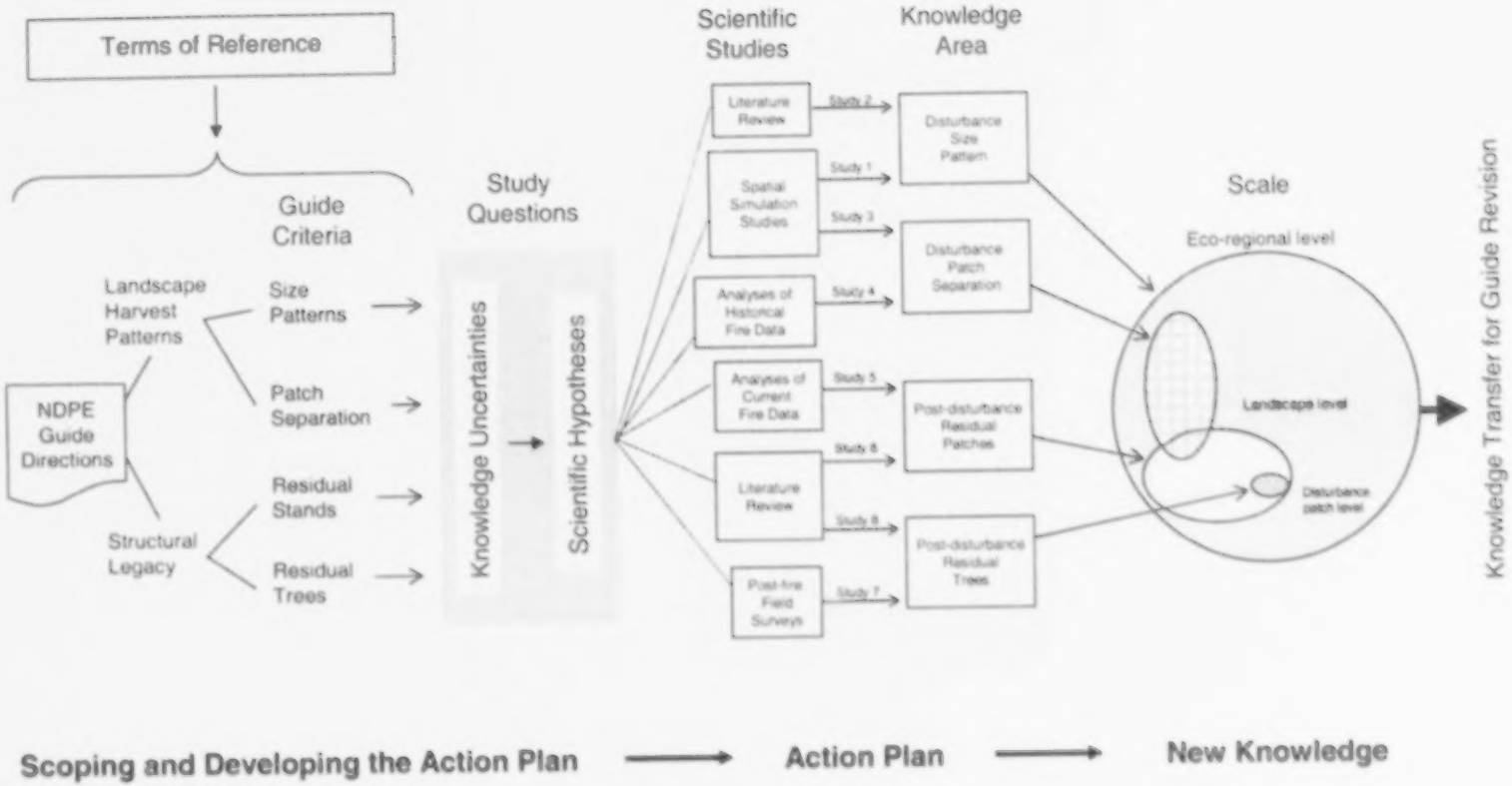

Figure 1. Schematic overview of the development and details of the action plan for scientific studies to assess the effectiveness of the Guide.

Appendix 1. Terms of Reference for Developing EA Condition 39c Action Plan (Feb 13, 2004)

Background
The Action Plan for Condition 39c will address specific requirements of the condition contained in the declaration order as follows:

"Within one year of this Declaration Order coming into force, MNR shall complete an action plan which shall describe scientific studies that shall ***assess the effectiveness of the direction*** *for* ***clearcut sizes***, ***separation criteria*** *for planned clearcuts, and standards for* ***residual stand structure in MNR's approved forest management guide*** *relating to the emulation of natural disturbance patterns,* ***in providing for the emulation of natural disturbance patterns****. The action plan shall include implementation schedules for these scientific studies".*

Criteria for addressing effectiveness of the direction defined above will consider the purpose, objectives, and embedded assumptions contained in the *Forest Management Guide for Natural Disturbance Pattern Emulation*V3.1 (OMNR 2001).

Appropriate understanding of the other relevant science-related EA conditions (29, 30, 31, 38, 42, and 45) and their implementation plans is required for context, and identifying gaps and redundancies.

Goal
This action plan will focus on the specific direction provided in Condition 39c, not the broader need to monitor the overall effectiveness of the NDPE guide, which should be addressed by Conditions 29 (silvicultural effectiveness monitoring), 31 (effectiveness monitoring of guides), and 38 (development of landscape guide).

The goal is to develop an action plan that identifies the ecological knowledge uncertainties associated with emulating natural disturbances, specifically the effectiveness of the direction for **clearcut sizes**, **separation criteria for planned clearcuts**, and **standards for residual stand structure** in the NDPE guide, in *creating more natural landscape patterns* (the stated goal of the guide).

Effective here means how closely the criteria specified in the guide create patterns that resemble those created by natural disturbances (specifically by fire).

Deliverable
The product will be an action plan that will include a list of scientific studies to address above ecological uncertainties (not social or economic) with a proposed implementation schedule. This plan will be delivered for internal MNR review by May 15, with the final version ready for submission to MOE by June 25, 2004.

This action plan will contain the following:

- goals and objectives
- questions to be addressed
- description of activities
- implementation schedule
- roles and responsibilities for implementation
- expected accomplishments and outcome of the action plan.

It may include appendices that will provide additional details. It will be written for public consumption with minimal technical jargon and details.

Project Team
Ajith Perera and Lisa Buse

Steering Committee
The project team will report to the Steering Committee (Ed Iwachewski, Joe Kapron, and Brian Hillier). Joe Churcher, Laurie Mace, Michael Gluck and Jim Baker will act as advisors to the project team.